NOAA Lyman-α Total Water Hygrometer

Total water is measured *in situ* as vapor with a Lyman-α hygrometer (*Kelly et al*. [1989]). High ambient sample flows through a closed cell minimize the effect of trapped water. Lyman-α light (121.6 nm) photodissociates water to produce an excited OH radical. The fluorescence from this radical at 309 nm is detected with a phototube and counting system. At aircraft pressures the fluorescence signal is quenched by air which gives a signal that is proportional to mixing ratio. The Lyman-α radiation produced with a DC-discharge lamp is monitored with an iodine ionization cell that is sensitive from 115 nm to 135 nm. Calibration occurs in flight by injecting water vapor directly into the ambient sample flow. This instrument has operated onboard the NASA ER-2 high-altitude research aircraft on numerous flights beginning in the mid-1980's (see Table below). More recently, the instrument has been integrated onto the NASA WB-57F high-altitude research aircraft and operated successfully in the RISO, WAM, and ACCENT missions.

Accuracy:	10%
Precision:	5%
Response Time:	1 second
Weight:	29 kg
Power:	250 W max.(28 VDC), 600 W max (110 VAC 400 Hz 1-phase)

Missions and latitude coverage for NOAA-AL Lyman-α hygrometer

Mission Base	Location	Lat range	Time Span	Platform	Hours
STEP	Panama	9N - 3N	1980	U-2	56
ACE	California	49N - 31N	1980 - 1982	U-2	105
Bal. Intercomp.	CA/WY/TX	39N - 32N	1981 - 1983	U-2	90
STEP	California	43N - 37N	1984	U-2	28
STEP	Darwin, Australia	37N - 30S	1987	ER-2	121
AAOE	Punta Arenas, Chile	37N - 72S	1987	ER-2	120
AAOE	Punta Arenas	53S - 90S	1987	DC-8	104
AASE	Stavanger, Norway	82N - 37N	1988 - 1989	ER-2	123
AASE	Stavanger	90N - 59N	1989	DC-8	112
SAGE Validation	California	37N - 34N	1991	ER-2	11
PEM WEST	Pacific Rim, Equator	60N - 0N	1991	DC-8	190
AASEII	Bangor&Fairbanks	90N - 22N	1991 - 1992	ER-2	202
SPADE	California	60N - 14N	1992 - 1993	ER-2	86
ASHOE/MAESA	New Zealand	61N - 70S	1994	ER-2	274
WAM/RISO	Houston	45N - 10N	1998	WB-57	30
ACCENT/RISO	Houston	45N - 9N	1999	WB-57	44

Selected References:

Kelly, K. K., et al., Dehydration in the lower Antarctic stratosphere during late winter and early spring, 1987, *J. Geophys. Res*., 94, 11317, 1989.

Kelly, K. K., et al., "A comparison of ER-2 measurements of stratospheric water vapor between the 1987 Antarctic and 1989 Arctic airborne missions", *Geophys. Res. Lett.*, *17*, 465, 1990.

Kelly, K. K., et al., "Water vapor and cloud water measurements over Darwin during STEP 1987 tropical cloud mission", *J. Geophys. Res.*, *98*, 8713, 1993.

Knollenberg, R. G., et al., "Measurements of high number densities of ice crystals in the tops of tropical cumulonimbus", *J. Geophys. Res.*, *98*, 8639, 1993.